

the local clock at the next hour (11 A.M.) would show that this clock had been properly corrected, and would be a guarantee for the general accuracy of the time-signals. Preliminary trials have shown that the observation of coincidence of vibration of two pendulums can be made with great certainty, and Messrs. E. Dent and Co. are now arranging for the mounting of an auxiliary pendulum on one of the transit of Venus clocks, and for adapting it to give hourly time-signals.

The errors of the Westminster clock have been under 1s. on 50 per cent. of the days of observation, between 1s. and 2s. on 29 per cent., between 2s. and 3s. on 10 per cent., between 3s. and 4s. on 7 per cent., and over 4s. on 4 per cent.

During the past year the Observatory has lost the valuable services of Mr. Dunkin, who retired on August 25, after an honourable service of forty-six years, which has been throughout characterised by remarkable zeal and ability, and has contributed largely to maintain the credit of the Observatory. Mr. Dunkin has been succeeded in the post of Chief Assistant by Mr. H. H. Turner, B.A., of Trinity College, Cambridge.

The report concludes as follows:—

During the past year the various classes of work carried on in this Observatory have been somewhat extended. The meridian observations are more numerous than usual, and various subsidiary investigations involving considerable labour have been undertaken with a view to increase their accuracy. A large number of spectroscopic determinations of star-motions have been obtained, and the long continued maximum of sun-spots has made the photographic measurements and computations much heavier than in any previous year. Extensions have also been made in the magnetic and meteorological branch, which appeared very desirable, but which have pressed rather severely on Mr. Ellis and his staff.

Turning to the future, I wish to invite the attention of the visitors to the circumstance that an increase in our optical means is required to enable us to carry out satisfactorily the determinations of proper motions of stars in the line of sight with the spectroscope, a work which peculiarly belongs to this Observatory, as supplementing the determinations of proper motions from meridian observations.

The aperture of our largest refractor (12½ inches) is too small to allow of our observing successfully with the spectroscope any but the brightest stars, and though the Lassel reflector is somewhat more powerful, its mounting and clock-work are not adapted to carry a heavy spectroscope with the necessary steadiness and accuracy of motion. The firmness of the mounting of the south-east equatorial and the perfection of its clock-work would make it peculiarly suitable for this class of work if it carried a much larger object-glass.

After careful consideration of the conditions I have satisfied myself that an object-glass of 28 inches aperture and of 28 feet focal length could be mounted on the south-east equatorial, in place of the present object-glass of less than half that aperture; and I have ascertained that Mr. Grubb would be prepared to undertake the construction of such an object-glass with a tube suited to the special requirements of the case, so that the telescope would be equally available for eye-observation or for use with the spectroscope. With Mr. Grubb's assistance, I have prepared a model showing how this may be arranged.

While a large refractor is required specially for spectroscopic observations, it seems desirable also on other grounds that this Observatory should possess an equatorially mounted telescope comparable with those of other first-class observatories, so that we may no longer be prevented by deficient optical means from obtaining complete series of observations of comets and faint satellites.

VIVISECTION

A RETURN has been issued by the Home Office containing the reports of inspectors showing the number of experiments performed on living animals during the year 1884 under licences granted according to the Act 39 and 40 Victoria, c. 77, distinguishing painless from painful experiments.

The former of the two reports deals with England and Scotland, the latter with Ireland. They are as follows:—

"(1) The names of the 49 persons who held licences during any part of the year are given in the subjoined tables, in one of which are entered the names of those licensees who performed any experiments, 34 in number; and, in the other, the names of those who performed none.

"(2) The total number of experiments of all kinds performed during the year was about 441.

"Of these, 140 were done under the restrictions of the licence alone, 78 under the same restrictions, but under certificates in column 1 (lecture illustrations); 145 under certificates in column 2; 76 under those in column 3; and 2 under a certificate in column 4.

"(3) With regard to the infliction of pain, as in all the experiments, except those under special certificates in columns 2, 3, and 4, the animals are rendered insensible during the whole of the experiment, and are not allowed to recover consciousness, no appreciable suffering would be caused if the provisions of the Act are faithfully carried out, as there is not the least reason to doubt they were.

"With respect to experiments under certificates in columns 2, 3, and 4, which dispense either wholly or partially with the use of anaesthetics, it should be stated:—

"(a) That of the 145 experiments performed under certificates in column 2, 99 consisted in simple inoculation with a morbid virus, in which no operation beyond the prick of a needle was required, and for which the administration of an anaesthetic would only have entailed needless annoyance and distress to the animal. In these experiments any appreciable suffering would be felt only in those cases in which the inoculation took effect, involving about the same amount of pain as ensues on ordinary vaccination, before the brief period the animals were allowed to survive. Of such cases, according to the returns I have received, about 16 occurred. Of the remaining 46 experiments under these certificates, 24 were performed for the purpose of medico-legal inquiries in cases of suspected poisoning, resulting in the death by tetanus of three frogs and six mice, which survived, however, only a few minutes; 10 other cases under the same head were experiments on the infection of fish with a species of fungus, very destructive in certain rivers and streams; and five on the effects of immersion of fish in distilled water, which proved fatal to about thirty minnows and sticklebacks. In none of these cases could it be said that any appreciable suffering was inflicted. In seven cases, in which salts of ammonia were hypodermically injected, two are returned as having suffered pain, but of a very trifling character.

"(b) Of the 76 experiments under certificates in column 3, 47 required a simple operation, but this being done under anaesthesia, was unfelt, and the after-effects, though in many of the cases resulting in partial paralysis, are reported as having been unattended with actual pain in any case. The remaining 29 were by simple inoculation, and none were attended with pain.

"(4) In conclusion, therefore, it may be stated that the amount of direct or indirect actual suffering, as the result of physiological and therapeutical experiments performed in England and Scotland, under the Act in the year 1884, was wholly insignificant.

"GEORGE BUSK, Inspector

"The Right Hon. the Secretary of State."

"16, Harcourt Street, Dublin, May 17

"SIR,—In accordance with your instructions I beg to submit the following table, showing the licences in force in Ireland during the year 1884 under the Act 39 and 40 Vict., c. 77. No certificate has been allowed during the year.

"Several of the licences in force during the previous year have expired, and renewals have not been sought for.

"Under the licences in force thirteen experiments have been made; they were all painless. I am of opinion that the experiments in question were useful ones; eleven of them were intended to elucidate the actions of drugs, and the remaining two to assist the investigation of certain circulatory phenomena which have a bearing upon the treatment of disease.

"I have, &c.,

"W. THORNLEY STOKER

"To the Right Hon. the Chief Secretary for Ireland."

In each case the report is followed by a list of all persons who hold such licences, the places where they are permitted to make experiments, and the nature of the certificate held.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The Annual Report of the Museums and Lecture-Rooms Syndicate, recently published, contains the

reports of all the professors, lecturers, and heads of departments connected with natural science.

Prof. Thomson (Cavendish Professor of Physics) reports that during the Lent term ninety students attended the demonstrations, and there were ten persons doing original work in the laboratory. Lord Rayleigh states that during the last five years about 2500*l.* has been spent on the Cavendish Laboratory in addition to the University expenditure. This has come partly from fees, partly from the apparatus fund raised by subscription.

The Chemical Laboratory has been much over-crowded and improvements are scarcely possible until the new laboratory has been completed.

The register of the mineralogical collections is completed. The number of students increases; fifteen attended Mr. Solly's demonstrations in the Michaelmas term and nineteen in the Lent term.

The department of mechanism has continued to grow rapidly. During the year two new workrooms and a new foundry have been added and have met the most urgent requirements. Upwards of 1000*l.* worth of new machinery has been added at Prof. Stuart's expense during the last two years to meet immediate wants; and during that time the pupils have doubled in number. The lecture-rooms have become over-crowded, and new ones are much wanted. Prof. Stuart urges that the University should now purchase the machinery and apparatus used in teaching, which is his property. The undertaking is now wholly self-supporting, paying interest on the capital involved, and providing an adequate sinking fund.

The classes of practical morphology and elementary biology are now much better accommodated in the new rooms. One hundred Zeiss's microscopes have been purchased. The Balfour library has been enlarged, and proves of great value to students. Seven demonstrators have been fully occupied in the classes, in addition to two ladies who have superintended the women students. In the May Term, 1884, in which two years of students were combined, 206 men and 12 women went through the course of elementary biology. In the Lent term of 1885, 128 men and 7 women attended. In Elementary Morphology there were 68 students in last October term, and 87 in the recent Lent term.

Prof. Macalister has utilised the services of seven assistant Demonstrators, in addition to Mr. Hill, whose labour has been unremitting. Subjects for dissection have been secured from a wide area. Prof. Macalister has presented a series of models of the viscera of the body showing their proper relative positions, casts of frozen sections, 26 crania, and 160 specimens of bones showing peculiarities. No department of University work is so badly housed as the Department of Anatomy; but much good work is done in the limited space.

In the Museum of Comparative Anatomy and Zoology 72 additional species from Dr. Dohrn's collection have been re-mounted and displayed. An extensive collection of marine invertebrata from the New England coast has been forwarded from the National Museum at Washington, through the kind offices of Prof. Baird. The work of the Curator in Invertebrate Zoology has been principally expended upon the MacAndrew collection of shells. Mr. Cooke has published two extensive papers, and progressed with the rectification of the nomenclature and the catalogue.

A fine adult *Echidna* from New Guinea has been presented by Dr. Guillemard. Both skin and skeleton have been mounted. A complete skeleton of the red deer in a sub-fossil state has been procured from Burwell Fen by Mr. W. Stubbings, Assistant in the Museum; a complete skeleton of an African elephant, shot by Mr. W. Heape near Port Elizabeth, has been presented. Many other interesting acquisitions are named in the report.

Dr. H. Gadov, the Strickland Curator, has been forming a manuscript catalogue of the skins of birds in the Museum. An exhibited series of specimens is being placed systematically, with the important anatomical parts, nests and eggs, in an educational series. Twenty maps have been placed in the cases to illustrate the geographical distribution of birds. The University collection now consists of 9653 specimens of 3290 species. The Strickland collection, in addition, contains 600 specimens of 3125 species; and, with Mr. E. Newton's collection, there are in all 17,000 specimens, representing probably 4500 species.

Prof. Foster reports that the number of students of elementary physiology has risen from 77 in the Easter term, 1884, to 141 in the recent Lent term, exclusive of women students. Twenty-

eight have attended advanced lectures also. Several important additions, such as a gas-engine, a centrifugal machine, recording and other apparatus, have been made to the Laboratory, by the aid of a gift of 500*l.* by an anonymous donor. The inadequacy of accommodation, both for practical work and for lecturing, is severely felt.

Prof. Ray has been successful in organising extended practical courses, as well as systematic lectures. The *post-mortem* examinations at Addenbrooke's Hospital have been placed under his superintendence. At present the only laboratory space available is obtained by encroaching on Dr. Foster's already overcrowded rooms.

Prof. Babington reports that the arrangement of the general Herbarium is now complete. The plants have been placed in orders and genera, according to Bentham and Hooker. The arrangement of species has not as yet been attempted. Mr. Potter and Mr. Gardiner have commenced the formation of a small Botanical Museum similar to that of Comparative Anatomy. Mr. Vines finds the new rooms very suitable both for class purposes and for research. Last term there were 29 advanced and 30 elementary students working in the laboratory.

The Geological Museum has acquired a fine collection of fossils from the Oolites of Dorset, chiefly by the liberality of Prof. Henry Sidgwick. Messrs. Roberts and Small brought useful additions from the Jura. Mr. Marr has added largely to the Cambrian and Silurian series. Mr. Keeping has collected and restored many specimens from Pliocene and Pleistocene deposits. Mr. J. Roberts has worked most energetically as Prof. Hughes' assistant, in the museum, in teaching and collecting. Work is much hindered by the want of a lecture room and class-room.

Mr. Walter Gardiner, whose original work in vegetable histology is so well known, has been elected to a Fellowship at Clare College.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 6.—"On charging Secondary Batteries," by William Henry Preece, F.R.S.

Mr. Preece said he had for some months past been experimenting with secondary batteries with a view of getting an efficient, uniform, and constant source of current for electric lighting his house. The cells are of the Planté type, manufactured by the Elwell Parker Company of Wolverhampton. Each cell contains fourteen plates of plain sheet lead 17" X 11", which are suspended in well-insulated wood boxes filled with diluted sulphuric acid in the proportion of about 1 to 19. These plates are grouped in two groups of seven, each group being soldered to a lead strip, forming alternately the positive and negative poles of the cell. The plates of the respective poles are prevented from touching each other by ebonite grids or separators introduced by Mr. Charles Moseley to prevent short-circuiting through the buckling of the plates. Each plate offers a surface of 1.3 square feet, so that the total surface of lead of each group opposed to each other is 9.1 square feet; that is, 9.1 square feet of peroxidised lead is opposed to 9.1 square feet of spongy lead. Mr. Preece employs 24 of such cells. The charging current varies from 3 to 3½ amperes per square foot, while the current of discharge used in lighting his house varies from 1 to 1½ ampere per square foot. The total weight of each cell is 120 lbs. The plates are prepared by the Parker-Planté process before insertion in the cell, those forming the positive pole being well peroxidised, while those forming the negative pole are well coated with spongy lead. This process consists in immersing for a few hours the lead plates in a solution of nitric and sulphuric acids in the proportions—

Nitric acid	...	...	...	...	...	1
Sulphuric acid	...	...	...	...	...	2
Water	...	...	...	...	...	17

before fixing in the cells. This not only chemically cleans the lead surfaces, but it favours the formation of sulphate of lead in such a way as to be readily converted into lead peroxide and spongy lead on the passage of a strong current through the cells. The formation of the cells is thus expedited. They are thus, when put together, prepared at once to be charged. If they are not at once charged, local action sets in, and lead sulphate is injuriously formed.

A hydrometer, having a scale graduated from 1.050 to 1.150,